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ULTRASONIC TESTING APPARATUS

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54) **Ultrasonic Testing Device**

The ultrasonic testing device for testing, especially of test objects such as railway railing(4), test head elements(7) built as electromagnetic ultrasonic transducer are arranged on the roller surface(2) on the flat surface(3) of the railway rail(4), the echo signals received are evaluable with a control and evaluation circuit as a function of the position of the test wheel(1), which can be determined with a position detection device(15,16,17). This ultrasonic testing device is characterised by the fact that at high translational velocities of the test wheel(1), as well as at a junction point of the railway rail(4) indicated by a device, the ultrasonic testing can be carried out close to the junction point, with highly diminished acoustic noise.

Description:

The invention deals with an ultrasonic test device for testing, specially test bodies in the form of railway rails built as electromagnetic ultrasonic transducer with at least one of the test bodies facing sending/receiving side of each test head with which the ultrasonic in the test body can be coupled.

A similar ultrasonic testing device is well-known from the publication, "Ultrasonic Inspection of Railroad Rails by Electromagnetic Acoustic Transducers (EMATS)' by L.J.Graham and J.F.Martin which appeared in May 1986 as the final report for the U.S Department of Transportation, Federal Railroad Administration, Office of Research and Development with the No. FRA/ORD-86/09. In this ultrasonic testing device, electromagnetic transducers are provided as test bodies, with which by displacement of the test bodies along the length of the railroad rail, the discontinuities in the fish-plate surface or cross defect in the rail head along the displacement path can be detected.

In this ultrasonic testing device use of a coupling medium like water is avoided through the electromagnetically induced coupling of ultrasonics in the test bodies in the form of railroad rails, however, the electromagnetically operated test heads show an inhomogeneous magnetic fields owing to their

mode of construction which in case of displacement of the test head cause a movement-induced acoustic Barkhausen noise, which overlap with the echo signals being detected and render detection of discontinuities difficult, especially in the case of faint echo signals. Besides, for coupling of sufficiently high ultrasonic intensity, a very small clearance of the test head from the surface of the rail head is necessary. Thus, however on account of minute rail unevenness, especially at discontinuities of rail road with rails not welded with each other, the test heads are exposed to a high destruction risk.

Further testing of unwelded railway rails with a similar ultrasonic testing device show mostly a large height adjustment, and high translation velocities of e.g. 80 kms / hr, are possible at a high expenditure, since a safety device has to be provided to protect the test head against destruction, which detects the junction points located in front of the test head, in the direction of movement and the test head is raised sufficiently high at a distance from the junction point, before crossing the junction point.

Besides the high equipment cost, it is especially disadvantageous that the danger exists in that the terminal region of the railway rail is not tested in the region of the junction point, because of which the junction points have to be retested by a very expensive postirradiation examination.

Another ultrasonic testing device is well-known from the article " Rail Testing with Ultrasonics and the Ultrasonic Rail-inspection Vehicles of the German Railways" by E.Martin and K.Werner, from the publication, " Railway Technical Review" Vol. 12.5, appearing in December 1956. In this ultrasonic testing device, an acousto-mechanically operated test head is provided, which can be dragged along the length of the railway line to be tested, for which for coupling can be supplied from a hydraulic coupling tank, in the contact region between the test head and the railway rail.

In one of the development stages of this ultrasonic testing device, the test head is fitted on a monorail vehicle movable manually over the railway rail, so that the defective positions are recognisable by direct observation on an screen. For higher translational velocities, the ultrasonic testing device is fitted on a ultrasonic rail-inspection vehicle, which moves with a typical translational velocity of about 30 kms / hour, along the length of the railway rail, whereby an automated display recording of received echo signal is obtained as a function of the path of movement.

With a similar ultrasonic testing device movable along the length, rail track equipment free from movement-induced Barkhausen noise on defective positions can be reliably tested, however, introduction of a similar ultrasonic testing device in winter operation at very low temperatures, with the usual application of water as hydraulic coupling is severely restricted, since the

danger of ice formations exists, for which an economical additions of salt leads to an undesirable pollution of the environment as well as operational technical problems on account of corrosion. In order to avoid the corrosion problem, denatured alcohol may be used as coupling medium, but it results in very high costs.

The finding is the basis of the task, that an ultrasonic testing device of the type mentioned in the beginning, with which exceptionally noiseless testing, especially of test bodies showing a height adjustment, can be rationally carried out.

In this invention this task has been accomplished by fitting more test heads face to face with flat surface of the test heads rolling one over the other. By this the sending/receiving side of each test head facing the test body is arranged in the contact region of the roller surface with the test body.

Thus the test heads are fitted on the test wheel rolling over the surface of the test body, test bodies with a height adjuster in the region limited to the height adjuster can henceforth be investigated at a relatively lesser expenditure, since by rolling the test wheel, the test body is protected against damages when brought closer to the junction point by rolling over the junction point of the test wheel. By rolling of the test heads over the surface of the test bodies, limited by guaranteed close proximity of the test bodies to the

surface, sufficiently intensive ultrasonic signals can be coupled for detection of echo signal,. Further the relatively high acoustic Barkhausen noise is avoided, that compulsorily appear in the case of longitudinally moving ultrasonic test devices on account of the magnetisation through spatially inhomogeneous magnetic fields.

In a preferred embodiment, many tested elements forming the test head are fitted onto the test wheel which are fitted on the outer surface of the test wheel. Thus the sending/receiving sides of the test head elements are arranged on the rolling surface of the test wheel and well protected against damage. The position of the test wheel and thus the position of the test elements can be determined with an optical position detecting device, whose output signals can be stored in a control and evaluation circuit, together with the measurement signals received by the test elements, so that starting from a reference position, defective positions in the railway rail can be localised after completion of the testing.

The embodiments of this invention are illustrated below. It shows:

Fig 1. A perspective view of a test wheel, equipped with test elements on the running surface during rolling on a railway rail

Fig 2. A longitudinal section through the wheel centre of the test wheel in the region of the railway rail

Fig 3. A cross section through the holder of the test elements in the test wheel.

Fig 4. An embodiment of test head elements

Fig 5. A further embodiment of a test head element

Fig 6. A block diagram of a control and evaluation circuit connected to the test head element.

Fig 7 A cross section through the wheel centre and wheel axis of the test wheel

Fig 1 shows in a perspective view a test wheel (1) which can be rolled with its running surface (2) serving as rolling surface on the rail surface (3) of a railway rail to be investigated. The test wheel (1) is fitted to the inspection vehicle, not shown in fig (1), with an axis provided with a hollow space (5) in

which the inspection vehicle is suitably equipped with two simultaneously rolling test wheels (1) on both railway rails (4) of a track.

A number of regularly spaced, contiguous test elements (7) are fitted on the running surface (2) of the test wheel (1). An individual test element (7) requires a surface of about 5 x 20 mm on the running surface (2) so that about 500 pieces of the test elements (7) are needed for the test wheel (1). For the sake of clarity, in fig (1) only few of the test head elements (7) are provided with a reference sign.

By arranging the test head elements (7) on the rolling surface (2) of the test wheel (1) it is guaranteed that testing can be carried out even with a height adjuster at the junction point, especially for unwelded but contiguous railway rail (4) since removal of the test head elements (7) during rolling of the test wheel (1) over the junction point is not required, it is possible to carryout testing close to the junction point, with the help of test wheel (1) even at high translational velocities.

Rolling the roller surface (2) of the test wheel (1) on the surface (3) of the railway rail (4), in turn the test elements (7) lie on the roller surface (3) of the railway rail (4). For the test head elements (7) with an interval of maximum of 0.5 mm from the surface, the roller surface (3) can be coupled on the ultrasonic sending/receiving side in the railway rail. For example, the baffle

reflection produced from the supporting surface (8) of the foot of the rail (9) can be used to check the coupling while those echo signals produced from the rail web (10) or the rail head (11) serve to detect the defects.

The test head elements (7) also allows to bring the rail head together and by the so-called "Phased array technique" manage the oblique radiations and vertical radiations defined through periodic activation of the test head elements (7) without changing the position of the test head elements (7) for detecting the horizontal and sloping defects originating mainly from the fish-bolt holes (12)

Through the free-sliding rolling of the roller surface (2) on the rail surface (3), the relative speed between the test head elements (7) and the railway rail (4) in the contact region of the roller surface (2) and the rail surface (3) is essentially zero, so that the movement–induced, acoustic Barhausen noises following the spatial inhomogeneous magnetic fields are avoided and the signal to noise ratio is clearly enhanced in comparison to the testing device in which the test heads are lead parallel to the roller surface (3) of the railway rail (4).

In case of the embodiment shown in fig (1) the position mirror (14) arranged in a radial direction is brought on the innerside (13) of the test wheel fitted on the test wheel axis(6). It is advantageous that the radial arrangement of the

position mirror (14) corresponds to the radial arrangement of the test head elements(7) whereby the width of the position mirror (14) correspond to the angular segment originating from the middle point of the test wheel (1), enclosing the sideways limitation of the arranged test elements (7). On the underside of the inspection vehicle, a laser (15) servicing as a light source and a photo detector (16) are provided, which are not shown in fig (1).

The laser (15) and the photo detector (16) are arranged such that a laser beam (17) emitted from the laser (15) on reflection at the position mirror (14) is brought into position in the upper part of the wheel crown and strikes the photo detector (16).

In case of a modified embodiment, beside the position mirror (14) a rim of test head element mirrors arranged wider than the individual test head elements (7) are brought into position on the inner side of the test wheel. Thereby a precise determination of the position of the test wheel (1) is possible.

Further it is possible, to install a mirror corresponding to the position mirror (14) on the holder of the inspection vehicle and to install a sending and receiving element corresponding to the laser (15) and the photo detector (16) on the inner side (13) of the test wheel (1). Further in the case of embodiments not illustrated, in place of the position mirror (14), mechanical

or electrically working position indicator of a position detection device are arranged with which the position of the test wheel (1) can be detected.

Fig (2) shows a longitudinal section through the wheel rim of the test wheel (1) along the roller surface (3) of the railway rail (4). The test wheel (1) rolls in the rolling direction (18), while the test wheel (1) rolls in the direction of travel (18); the test elements (7) coming next on the roller surface (3) are synchronised to the test head(19). Thus the test head element (7), lying next to each other in relation of the roller direction (18) and the test head element (7) approaching the roller surface (3) is synchronised to test head (19) and simultaneously, the test head element (7) of the test head (19) lying far behind in relation to the roller direction (18) and far away from the roller surface (3), are deactivated.

Through the “Phased–Array technique” already mentioned above, it is possible to couple the test head (19) built from the test head elements (7) ultrasonically as well as orthogonally to the roller surface (3) in the direction of the arrow (20) and also at an angle to the roller surface (3), e.g. in the direction of the arrows (21) & (22) in the railway rail (4).

Fig. 3 shows a cross-section through the test wheel 1 as well as the railway rail 4 for a contact area 2 between the roller surface 2 and the running surface 3. The test head element 7 is installed in a recording chamber 24 open in the direction of the running surface 3 breaking through the roller surface 2 of the test wheel 1. The measuring side 25 of the test head element 7 turned towards the running surface 3 of the railway rail 4 is at an interval of maximum one millimetre, however preferably maximum 0.5 millimetre, from the running surface 3 in the contact area 23 of emitting/receiving side. The small interval ensures an operationally safe coupling of the test head element 7 to the railway rail 4 for an execution of the test head element 7 as electrodynamic ultrasonic transducer. A test head element magnet 27 is placed on the fixing side 26 of the test head element 7 in the recording chamber 24, which rests upon a chamber collar 28 with border edges formed by the transition of test head element area 29 housing the test head element 7 to the magnet area 30 of the recording chamber 24.

A test wheel magnet 32 is placed in the magnet area 30 of the recording chamber 24 on an inside wall 31 of the recording chamber 24 lying opposite the test head element magnet 27. For the embodiment illustrated in fig. 2, the test wheel magnet 32 is a permanent magnet while the test head element magnet 27 is executed as an electromagnet controllable with different current intensities. In a modified embodiment, not illustrated, a controllable electromagnet is provided as test wheel magnet 32 and a permanent magnet as test head element magnet 27.

The measuring side 25 of the test head element 7 can be adjusted essentially at right angle to the normal to the surface of the running surface 3 by resting the test head element magnet 27 on the chamber collar 28 as well as by the magnetic forces acting during the operation of the test head element 7, so that a proper coupling of the test head element 7 is ensured even in case of small changes in the support. Appropriately, the test head element area 29 is shaped in conical fashion from the magnet area 30 towards the roller surface 2 in order to ensure a reliable guidance of the test head element 7. The magnetic forces between the test head element magnet 27 and the test wheel magnet 32 can be controlled in such a way, depending on the rotating speed of the test wheel 1, that they are slightly smaller than the centrifugal force acting radially outwards with respect to the test wheel 1 as well as the additional rectified magnetic forces between the test head element 7 and the railway rail in the contact area 23, as explained in detail further below. By this means, the test head element 7 can be pulled in the direction of the running surface 3 for the coupling during the entry of the test head element 7 in the contact area 23. Otherwise, the test head element 27 lies on the test wheel magnet 32 and the test head element 7 is withdrawn into the inside of the recording chamber 24 to protect against damages.

For a modified embodiment, not illustrated, the test head element 7 is supported elastically in the recording chamber 24. This can be managed through elastic supporting material filling up the recording chamber 24 or by suitable springs. Besides, the test head element 7 is movable to such an extent that the right angular alignment of the measuring side 25 with respect to the normal to the surface of the running surface 3 is ensured and that the movements of the test head element 7 in the direction of the normal to the surface caused by the magnetic forces and the centrifugal forces can be carried out.

The conductors leading to the test head element 7 and the test head element magnet 27 are laid in a conductor channel 33.

Fig. 4 shows the construction of the test head element 7 in section. The test head element 7 has a sealing block 34, which is made out of a material that is relatively hard, abrasion-resistant and permeable to electromagnetic waves. The test head element magnet is placed on the fixing side 26 of the sealing block 34.

Bar-shaped permanent magnets 35 and 36 are arranged adjacent to the measuring side 25 with alternating polarities N for magnetic north and S for magnetic south with their flat sides arranged contiguous to the measuring side 25, in which a high frequency coil 37 is provided between the measuring

side 25 and the arrangement of the permanent magnets 35 and 36 with alternating sense of winding corresponding to the polarity of the permanent magnets 35 and 36. The test head element 7 constructed according to fig. 4 is suitable for the production of horizontally polarised transverse waves (SH-waves).

Fig. 5 shows an additional embodiment of the test head element 7 for the production of horizontally polarised transverse waves. This test head element 7 has an annular band core 39 wrapped and magnetisable by a high frequency coil 38. The annular band core 39 is shaped semicircular and is arranged in the sealing block 34 with its ends pointing in the direction of the measuring side 25. Bar-shaped permanent magnets 40 are arranged between the ends of the annular band core 39, which extend with their longitudinal direction between the ends of the annular band core 39. The test head element 7 illustrated in fig. 5 can be manufactured with a relatively low production cost.

Fig. 6 shows an embodiment of a control and evaluation circuit 41 in a block flow diagram. For this control and evaluation circuit 41, the photo-detector 16 is connected to a position indicator 43 via a photo-detection conductor 42. The position indicator 43 determines the time between two measuring pulses of the photo-detector 16 and calculates from that the circumferential speed of the test rim 1.The position indicator 43 produces a magnetic control signal

for the subsequent rotation of the test rim 1 based on the time interval measured between two measuring pulses of the photo-detector 16. This magnetic signal can be fed to a magnetic control unit 44, which controls the test head element magnets 27 attached to the test head elements. In the case of the embodiment illustrated in fig. 3, the test head element magnets 27 can be controlled with the magnetic control unit 44 in such a way that the attractive forces acting between the test head element magnets 27 and the test rim magnets 32 are smaller than the centrifugal force which act depending on the speed of rotation of the test rim 1 as well as the magnetic attractive forces between the test head elements 7 and the running surface 3.

A trigger signal can be fed to the trigger line 45 by the position indicator 43. The trigger line 45 is connected to the pulse generator 46. A high-frequency signal produced by a high-frequency generator 47 can be supplied to the pulse generator 46 for the production of ultrasonic waves in the railway rail 4. Transmitting pulses can be produced with the pulse generator 46 with the high frequency fed by the high frequency generator 47 as carrier frequency depending on the trigger signals produced by the position indicator 43. The resultant frequency of the transmitting pulses can be set by the frequency of the trigger signal supplied by the position indicator 43 in such a way that one transmitting pulse is produced for about every three millimetre rolling path of the test rim 1. Typically, the resultant frequency of the transmitting pulses sent out by the pulse generator 46 for a circumferential speed of the roller

surface 2 of 80 kilometres per hour lies at about seven kilohertz. The duration of the transmitting pulses amounts to minimum of about ten cycles of oscillation of the carrier frequency.

The transmitting pulses attached to a high frequency output of the pulse generator 46 can be fed to the transmission delay elements 48, with which the transmitting pulse can be delayed by a definite duration according to the desired emitting direction of the ultrasonic signal to the railway rail 4. The output signals of the transmission delay elements 48 can be supplied to subsequent power amplifiers 49, whose outputs are connected to a transmission multiplexer 50. The number of transmission delay elements 48 and the power amplifiers 49 matches the test head elements 7 forming the test head 19.

The transmitting pulses produced by the power amplifiers 49 can be supplied to the test head elements 7, which form the test head 19, with the transmission multiplexer 50. The selection of the test head elements 7 takes place through the position indicator 43, which calculates the current distance of the test head elements 7 from the running surface 3 from the calculated circumferential speed of the test rim 1 and from the known position of the test head elements 7 on the test rim 1. The position indicator 43 selects the test head elements 7 lying next to the running surface 3 and produces a corresponding selecting signal, which can be supplied both to the

transmission multiplexer 50 as well as to a receiving multiplexer 52 and a sensor multiplexer 53 via a selection line 51.

The test head elements 7 forming the test head 19 are released by attached distance sensors 54 in case the distance to the running surface 3 falls below a minimum distance that can be preset as well as be impinged by arriving transmitting pulses, periodically transferred and produce an ultrasonic pulse in the railway rail 4 with oblique angled or right-angled propagation direction depending on the phase-shift of the transmission pulse. The ultrasonic pulses thrown back by the crack positions in the railway rail 4 or reflected at the surface of the railway rail 4 can be detected with the test head elements 7. The received signals are amplified by suitable amplifiers and fed to the receiving multiplexer 52 as received pulses.

The distance sensors attached to the respective test head elements 7 are provided for the calibration of the received pulses associated with the ultrasonic pulses thrown back, which, for example, determine the distance of the test head elements 7 from the running surface 3 according to the principle of eddy-current coils. In order to avoid faulty measurements, it is provided that only received signals, which occur at a distance of, for example, less than 0.5 millimetre of the test head elements 7 from the running surface 3, are considered.

The received signals of the test head elements 7 can be fed to the receipt delay elements 55 via the receiving multiplexer 52, to which again the output signals of the correlated distance sensors 54 can be supplied via the sensor multiplexer 53. Besides a correction of the received signals with regard to the distances of the test head elements 7 from the running surface 3, a reversal of the phase shift created by the transmission delay elements 48 can be carried out with the receipt delay elements 55.

The received signals from the receipt delay elements 55, corrected with regard to the phase shift and the distance of the associated test head elements 7 from the running surface 3, can be fed to a summation amplifier 56, which adds the received signals to a composite signal and amplifies, if necessary. The composite signal can be supplied to a data storage unit 57, in which the composite signal can be stored together with a correlated position signal supplied by the position indicator 43 to the data storage unit 57 via a position line 58.

The values stored in the data storage unit 57 can be localised by means of a data output unit 59 connected to the data storage unit 57 for localising faulty locations in relation to a reference position fixed at the beginning of the measuring cycle.

Fig. 7 shows a cross-section through the test rim 1, which makes clear a possible arrangement of the control and evaluation circuit 41 from fig. 6 in the test rim 1. The test rim 1 is assembled out of an inner and outer disc, which are screwed together, and made hollow inside. The inner disc has a circular opening, in which the test rim axle 6 is fixed. The high frequency generator 47, the pulse generator 46, the transmission delay elements 48 and the power amplifier 49 as well as the transmission multiplexer 50, the receiving multiplexer 52, a row of suitable receipt amplifiers 60, the receipt delay elements 55, the summation amplifier 56 and the data storage unit 57 are arranged in the hollow space 5 of the test axle 6. The transmission multiplexer 50 and the receiving multiplexer 52 are connected to the test head elements 7 arranged on the roller surface 2 via transmission lines 61 and the receiving lines 62 respectively. Besides, the position indicator 43, which is, for example, connected to a photo detector arranged on the inside 13 of the test rim 1, is also located in the hollow space 5. The power supply to the control and evaluation circuit 41 is managed either via a suitable transformer unit and a device for the rectification and regulation of the supplied alternating voltage or via friction contacts. Further, the data stored in the data storage unit 57 can be transferred to the data output unit 59, for example, via an optical interface. An optical serial interface comprises, for example, a light diode arranged on the symmetrical axis of the test rim axle 6, whose light beam running along the length of the symmetrical axis of the test rim axle 6 is linked to a stationery receiver fixed to the test vehicle via a suitable mirror arrangement.

Patent claims

1. Ultrasonic test device for the testing, especially of a testing body (4) in the form of railway rail with at least one test head (19) in the form of an electromagnetic ultrasonic transducer with a sending/receiving side facing the test body (4) with which ultrasound can be coupled to the test body (4), **characterised by that**, several test heads (19) are applied to a roller surface (2) of a test wheel (1) which can be rolled over a surface (3) of the test body (4), whereby the sending/receiving side (25) of each test head (1) facing the test body (1) is arranged in the contact area (23) of the roller surface (2) with the surface (3) of the test body (4).

2. Ultrasonic test device according to claim 1, **characterised by that**, the test heads (19) are arranged in test head elements (7) distributed at equal angular intervals and directly adjacent to each other on the roller surface (2).

3. Ultrasonic test device according to claim 2, characterised by that, a number of adjacent test head elements (7) can be connected together to the test heads (19).

4. Ultrasonic test device according to claim 2 or 3, characterised by that, the test head element (7) is provided in a recess (24) introduced in the test wheel (1).

5. Ultrasonic test device according to claim 4, characterised by that, the test head element (7) is supported in the recess (24) adjustable at right angle to the normal to the area of the surface (3) of the test body (4).

6. Ultrasonic test device according to one of the claims 2 to 5, characterised by that, the test head element (7) is provided in a sealing block (34).

7. Ultrasonic test device according to one of the claims 2 to 6, characterised by that, the test head element (7) can be withdrawn in the recess (24) with a withdrawing device (27, 32) for positions outside the contact area (23).

8. Ultrasonic test device according to claim 7, characterised by that, the withdrawing device has an arrangement provided in the recess (24) with a permanent magnet (32) and a controllable electromagnet (27).

9. Ultrasonic test device according to claim 8, characterised by that, the electromagnet (27) can be controlled in such a way, depending on the speed of rotation of the test wheel (1), that the withdrawing force on the permanent magnet (32) in the contact area (23) is less than the opposing centrifugal force and opposing attractive force between the test head element (7) and the test body (4).

10. Ultrasonic test device according to one of the claims 2 to 9, characterised by that, the distance of the test head element (7)

from the surface (3) of the test body (4) can be measured with a distance-measuring device (54).

11. Ultrasonic test device according to claim 10, characterised by that, the test head element (7) can be operated within a predetermined maximum distance from the surface (3) of the test body (4), measurable with the distance-measuring device (54).

12. Ultrasonic test device according to claim 10 or 11, characterised by that, the signal received from the test head element (7) can be calibrated with the distance detected by the distance-measuring device (54).

13. Ultrasonic test device according to one of the claims 2 to 12, characterised by that, the test head elements (7) forming the test head (19) can be steered periodically for the emitting of ultrasonic in different directions of radiation(20, 21, 22).

14. Ultrasonic test device according to one of the claims 2 to 13, characterised by that, the position of the test wheel (1) can be determined with a position-detecting device (14, 15, 16, 43).

15. Ultrasonic test device according to claim 14, characterised by that, the positions of the test wheel (1) can be changed with reference to a reference-position for the localised positions of the test body (4) with a computing unit (43).

16. Ultrasonic test device according to claim 14 or 15, characterised by that, the position-detection device has at least one reflector (14)

placed on the test wheel 91) with which light radiated from a light source (15) can be linked to a photo-detector (16).

17. Ultrasonic test device according to one of the claims 14 to 16, characterised by that, the ultrasonic signals received by at least one test element (7) at different positions of the test wheel (1) can be stored by coordinating the correlated positions of the test wheel (1) with an evaluation circuit (41), based on a reference position.

18. Ultrasonic test device according to one of the claims 2 to 17, characterised by that, the ultrasound can be radiated to a position of the test wheel (1) in at least two angular ranges.

19. Ultrasonic test device according to claim 18, characterised by that, the reflected ultrasonic signals received from at least two angular ranges can be stored independent of each other by coordinating to the position of the test wheel (1).